

Radiative Energetics of Mineral Dust Aerosols from Ground-based Measurements

SI-CHEE TSAY¹ and RICHARD A. HANSELL^{1,2}

¹Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, MD, USA

²ESSIC/University of Maryland, College Park, MD, USA

Airborne dust aerosols worldwide contribute a significant part to air quality problems and, to some extent, regional climatic issues (e.g., radiative forcing, hydrological cycle, and primary biological productivity in oceans). Evaluating the direct solar radiative effect of dust aerosols is relatively straightforward due in part to the relatively large S/N ratio in broadband irradiance measurements. The longwave (LW) impact, on the other hand, is rather difficult to ascertain since the measured dust signal level ($\sim 10 \text{ Wm}^{-2}$) is on the same order as the instrumental uncertainties. Although the magnitude of the LW impact is much smaller than that of the shortwave (SW), it can still have a noticeable influence on the energy distribution of Earth-atmosphere system, particularly due to the strong light-absorptive properties commonly found in many terrestrial minerals. The current effort is part of an ongoing research study to perform a global assessment of dust *direct aerosol radiative effects* (DARE) during major field deployments of key dust source regions worldwide. In this work we present results stemming from two previous field deployments: the 2006 NASA African Monsoon Multidisciplinary Activities and the 2008 Asian Monsoon Years, both utilizing NASA Goddard's mobile ground-based facility (*cf.* <http://smartlabs.gsfc.nasa.gov/>). The former study focused on transported Saharan dust at Sal (16.73°N, 22.93°W), Cape Verde along the west coast of Africa while the latter focused on Asian dust at Zhangye (39.082°N, 100.276°E), China near the source between the Taklimakan and Gobi deserts. Due to the compelling variability in spatial and temporal scale of dust properties during field experiments, a deterministic 1-D radiative transfer model constrained by local measurements (i.e., spectral photometry/interferometry and lidar for physical/microphysical, mineralogy, and single-scattering properties) is employed to evaluate dust's local instantaneous SW/LW DARE both at the surface and at the top of the atmosphere along with heating rate profiles for cloud-free atmospheres. In both dust cases the efficiency in the LW DARE is investigated and its significance is compared relative to that of diurnally averaged SW.